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# Hydrogen is an energy source for endosymbiotic bacteria of the vent mussel *Bathymodiolus puteoserpentis*

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Hydrogen is a potential energy source for bacteria providing an energy yield of roughly 240 kJ/mol if oxidized with oxygen. The ability to use $H_2$ as an energy source has been shown for a variety of free-living bacteria, while for symbionts of hydrothermal vents and cold seeps no other energy sources besides methane and sulfide have been identified until recently. Here we show that $H_2$ is utilized as an electron donor for $CO_2$ fixation by endosymbiotic bacteria of the Logatchev mussel *Bathymodiolus puteoserpentis.*

*B. puteoserpentis* lives in dual symbiosis with sulfide- and methane-oxidizing bacteria (type I methanotrophs). Initial incubation experiments in chilled sea water containing $H_2$ showed that freshly dissected *B. puteoserpentis* gill pieces consumed $H_2$, while no consumption was observed in controls with symbiont free tissue. Radiotracer experiments using $^{14}CO_3^{2-}$ as a carbon source in the absence of sulfide and $CH_4$ indicated that the presence of $H_2$ stimulates carbon fixation: The gill tissue clearly incorporated $^{14}C$ at rates comparable to those in the presence of $H_2S$. $CO_2$ fixation pathways are absent in Type I methanotrophs. Moreover, we found the large subunit of a membrane-bound respiratory uptake [NiFe] hydrogenase (*hynL*) in *B. puteoserpentis* and $B.$ aff. *thermophilus* from the Pacific Antarctic Ridge - a species that hosts only sulfide oxidizing symbionts. Therefore, our data strongly suggest that the sulfide-oxidizing en-

dosymbiont of *B. puteoserpentis* uses $H_2$ as an energy source.